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Title: Closure Cap

Specification

The present invention relates to a closure cap for openings of reservoirs, in particular motor vehicle radiators, as generically defined by the preamble to claim 1.

In one such closure cap, known from German Patent Disclosure DE 100 12 184 A1, an O-ring is retained on the valve body in a radially open, asymmetrical groove; the O- ring presses against the annular edge face, embodied as a sealing seat, of the cap inner part and thus seals off a flow connection between the inside of the reservoir and the outside of the reservoir. If at a defined upper limit value of the internal reservoir pressure the spring force that presses the valve body against the sealing seat is overcome, the flow connection is opened. Since the region of the O- ring located in the open, out of the asymmetrical radial annular groove, is located directly in the venting flow, there is a risk that the O-ring will be forced out of its seat or out of the annular groove by direct flow pressure and/or by venting flow turbulence. This means that the vent opening will be delayed in coming into action and/or that after the venting, the correct closure of the flow connection is no longer assured.

The object of the present invention is therefore to create a closure cap of the type defined at the outside, whose sealing seat, disposed between the cap inner part and the valve body facing it, experiences a defined tension relief upon opening of the venting flow path.

In a closure cap of the aforementioned type, the characteristics recited in claim 1 are provided for attaining this object.

By means of the provisions of the invention, it is attained that with the lifting of the valve body and thus the opening of the venting flow connection, the O-ring remains in the annular groove, since because the O-ring is ventilated from behind in the annular groove, a defined reduction of tension of the O-ring is attained, and the O-ring is prevented from sticking to the associated sealing face of the valve body.

In a refinement of the invention, according to the characteristics of claim 2, the venting pockets are provided on the side of the O-ring remote from the flow passage between the valve body and the cap inner part.

Further advantageous features of the venting pocket will become apparent from the characteristics of one or more of claims 3 through 5.

Further details of the invention can be learned from the ensuing description, in which the invention is described and explained in further detail in terms of the exemplary embodiment shown in the drawing. Shown are:

Fig. 1, in a longitudinal section, the cap inner part of a closure cap for a motor vehicle radiator with an overpressure/underpressure valve assembly, in a position after a limit value of the internal reservoir pressure is reached, in a preferred exemplary embodiment of the present invention; and

Fig. 2, a section taken along the line II-II in Fig. 1, but in the closed outset position and with existing internal reservoir pressure.

The closure cap 11, for instance for a motor vehicle radiator, shown in the drawing has, in a manner not shown, a cap outer part which is provided with an actuating handle and on which a cap inner part 14 with an underpressure/overpressure valve assembly 15 is retained. In the position for use, the closure cap 11 is affixed to or screwed onto a radiator neck, not shown. The cap inner part 14 protrudes inside the radiator neck in the direction of the radiator interior. An O-ring 16 on the outside, represented by dot-dashed lines, seals off the cap inner part 14 from the radiator neck wall. The overpressure part of the valve assembly 15 is embodied with two stages and serves in a first overpressure stage to prevent the radiator from boiling dry, and in a second overpressure stage, security against damage to the radiator system from excessive overpressure is assured.

The overpressure part of the valve body 15, in the interior of the cap inner part 14, has a first valve body 17, a second valve body 18, and a third valve body 19. The first valve body 17 is disposed above the second valve body 18 in the direction toward the outside of the cap, while the third valve body 19 is received coaxially inside the second valve body 18.

The first valve body 17 is embodied like a valve plate standing on its head; an annular seal 21 provided with an axially inward-oriented sealing face is mounted on the side of the plate toward the radiator interior. The first valve body 17 is acted upon, from a side facing away from the radiator interior, by a closing compression spring 22 represented only by dot-dashed lines, which is braced on its other end indirectly on the cap inner part 14 in a manner not shown. By means of the closing compression spring 22, the first valve body 17 is prestressed in the direction of the radiator interior. Via the seal 21, embodied as a flat sealing ring, the first valve body 17 is seated on a first annular sealing seat 24 of the second valve body 18. The one-piece second valve body 18 has a hood part 26, which on its free end is provided with the first sealing seat 24, and a receiving part 27 for the third valve body 19, which part is concentric and hollow-cylindrical and points from the bottom 28 of the hood part 26 toward the radiator interior. The bottom 28 between the hood part 26 and the receiving part 27 is provided on the outer circumference with a collar, whose underside 29 forms a second sealing seat relative to the cap inner part 14. Associated with this second sealing seat 28 is an inner O-ring 31, which is received in an annular groove 30 that is disposed in a collar edge 32 of the cap inner part 14 in such a way that it is open axially upward (toward the bottom 28 of the second valve body 18). The collar edge 32 is embodied between a hollow-cylindrical upper region, of the cap inner part 14 of larger inside diameter and receiving both the first valve body 17 and the hood part 26 of the second valve body 18, and a lower region of the cap inner part 14, of smaller inside diameter, surrounding the receiving part 27 of the second valve body 18. In this lower region, the cap inner part 14 is provided with an axial opening 33 for flow connection with the inside of the reservoir. In the outset state, not shown in Fig. 1, the first valve body 17 is pressed with its first ring seal 21 against the first sealing seat 24 of the second valve body 18 by the closing compression spring 22, and the second valve body is in turn pressed with its second sealing seat against the second ring seal (O-ring 31) on the cap inner part 14.

The annular groove 30, open axially upward, in the collar edge 32 of the cap inner part 14 is provided with venting pockets 35, which are formed by slots 36 that originate at the larger-diameter inner circumferential edge of the annular groove 30. The slots 36 extend over the entire axial depth of the annular groove 30. The slots 36 or venting pockets are distributed uniformly in a large number (in this case 16) over the circumference of the annular groove 30 (Fig. 2). Fig. 1

shows a flow connection 40, made when the second valve body 18 has lifted from the O-ring 31, from the inside of the reservoir to the outside of the reservoir between the inner edge of the collar edge 32 and the lower cap inner part region, and between the second sealing seat 28 and the O-ring 31. Fig. 2 also shows the location of the O-ring 31 in the annular groove 30 when the venting path 40 is closed, that is, in a position in which the second valve body 18 rests with its second sealing seat 28 on the O-ring 31 in the cap inner part 14 by the action of the closing compression spring 22. In this closing position, which seals off the flow connection or venting path 40 in pressuretight fashion, the O-ring 31 is compressed by the disposition of the venting pockets 35 and bulges radially outward in undulating fashion in the region of these venting pockets. That is, upon opening of the venting path 40 under the influence of an internal reservoir pressure that exceeds the applicable limit value, a defined reduction of tension of the O-ring 31 can be effected; as a result, the O-ring 31 cannot lift axially but instead remains inside the annular groove 30 in every case.

The following can be said about the operating conditions in the closure cap 11. In the outset operating position, not shown, the first valve body 17 is seated on the second valve body 18 (as in Fig. 1), and unlike what is shown in Fig. 1, the second valve body 18 rests on the cap inner part 14 or on the O-ring 31. If a first limit value of the internal reservoir pressure is exceeded, the first valve body 17 is lifted counter to its closing compression spring 22, since a communication exists between the inside of the reservoir and the underside of the first valve body 17, past the tightly closing third valve body 19 and through the second valve body 18. As a result of opening of a first flow connection, air from the air cushion located above the liquid radiator medium can flow outward and as a result can compensate for the overpressure or eliminate it. The second valve body 18 remains pressed in sealing fashion against the collar edge 32 of the cap inner part 14. If the so-called overpressure is reduced again to below the first limit value, then the first valve body 17 comes back into sealing contact with the second valve body 18. Conversely, if the internal reservoir pressure increases further even during or after the escape of the air cushion, the result is that liquid radiator medium reaches the underside of the second and third valve bodies 18 and 19, and in a manner explained for the prior art recited at the outset, a ram pressure results, leading to an axial motion of the third valve body 19 counter to its third compression spring 43; as a result of this sealing motion of the third valve body 19, the first flow connection mentioned is closed. Reducing the pressure leads

again to a reverse motion of the third valve body 19 and opening of this connection path, after which the first flow connection mentioned is closed again. Conversely, if the internal reservoir pressure continues to increase, then if an upper safety pressure limit value is exceeded, the second valve body 18 will lift from the O-ring 31 of the cap inner part 14, counter to the first closing compression spring 22 bearing on the first valve body 17, so that the so-called second flow connection 40 is opened, and the aforementioned very high overpressure can be reduced (see Fig. 1).

For the sake of completeness, it should also be noted that Fig. 1 also shows an underpressure valve body 57 inside the first overpressure valve body 17.

It is understood that the number of venting pockets shown in Fig. 2 may also be less or greater, and that the venting pockets may also be disposed in an irregular arrangement along the circumference of the annular groove. It is furthermore possible for the venting pockets to be provided not on the larger-diameter inside circumference of the annular groove but on the smaller-diameter circumference of the annular groove, radially inward. In an exemplary embodiment not shown, the venting pockets are formed by conically extended or stepped slots.